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AUTHOR Horowitz, Frances Degen
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ABSTRACT

Discussed are methodological aspects of three symposium papers on process approaches to individual differences in infancy. Fagan's (1987) research is viewed as an important contribution to the growing literature that demonstrates that process measures, that is, information processing behaviors, may provide a useful reflection of early to later relationships. Other findings suggest that state characteristics could also be important. Some process measures, such as number of fixations, proportion of time off the stimulus, and shift rate, may be indirect gradations of state fluctuations during an attentional episode. The goal of studies of information processing behavior as an individual difference characteristic is to account for the variance of the developmental outcome phenomena. Of utmost importance are the specific task measures for the explicit description of process and the implications that may be derived from introducing the role of state. State variability and organization may be individual difference characteristics that will permit researchers to describe how infants manage and modulate attentional behavior. If reliability is influenced by state factors, then the addition of state measures or some characterization of individual differences in state organization and management may be an important source for increasing the amount of variance for which researchers can account. (RH)

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Discussion of Papers Presented in the Symposium on Individual Differences in Infancy: Reliability, Stability and Prediction

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Frances Degen Horowitz

The University of Kansas

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There are some remarkable concordances among these three papers - the more so because they come from three entirely different laboratories using both similar and different research strategies. The concordances emerge as themes - two very strong ones. Namely, moderation in all - stability and predictability and inconsistencies in individual performance on task to task within session. And, there is a third theme which I have chosen to extract from these papers. It is related to issues of task analysis, meta-analyses and some of the larger implications of the work represented here for the broader questions of continuity and discontinuity in functional intelligences.

Because Fagan and his colleagues have investigated the relation of conditioning paradigm measures to later standard developmental or intelligence performance, their effort represents an important contribution to the growing literature which demonstrates that process measures - information processing behaviors - may provide a useful reflection of early to later relationships. On the other hand, the magnitude of the improved "predictive" utility of these process tasks can be questioned. For example, if one takes a mean of the correlations of the 3, 7 and 11 month retention ratios and baseline ratios to Stanford

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Binet and Bayley scores at 27 months and compares these means with the means of the correlations relating early Bayley scores to later Standford and Bayley scores the differences are not startling. As shown in Figure 1, from my calculations from Fagan's Table 3, there is not an appreciable overall gain of predictive utility of the conditioning relationships to later Stanford Binet and Bayley scores at any of the three stages.

Insert Figure 1 about here

These averages are, however, somewhat below the averages that one would derive from Bornstein and Sigman's (1986) meta-analysis where the overall predictive average is about .48; just those involving Bayley's and Stanford Binet scores is very similar: .47. Since Rose and Feldman only tested contemporaneous correlations and did not find anything (similar to Fagan's not finding a contemporaneous relationship) and since Colombo did not have any comparable data, it is hard to determine whether the somewhat lower relationships when the conditioning task is used is task related or of more general interest.

However, as Bornstein and Sigman (1986) have noted, novelty preference correlations to later standard infant measures account for a relatively small proportion of the variance so one must assume that other factors are at work in affecting developmental progress. This, of course, is the stimulus to putting the pieces of the puzzle together. Rose and Feldman and Colombo and his co-workers both report an interesting phenomenon - little consistency of performance within infants on different tasks measured at approximately the same time. Rose and Feldman use

this finding to question whether one is sampling the same domain; Colombo cautions that the inconsistency is reason to make multiple measures and aggregate. Rose and Feldman raise the question of "state" variations accounting for some of these inconsistencies. Since Madelyn Moss, in our laboratory, has found an interesting relationship between state measures on the Neonatal Behavioral Assessment Scale (Moss, 198) and a later habituation/dishabituation measure at three months, state characteristics could well be an important part of the picture that is emerging.

Now, you might say that all of the babies, by definition, are in roughly the same state - eyes open, seemingly alert, processing information. On the other hand, such a state description is gross in the extreme. Parmelee (In Press) has recently made the case that the alert state is not a homogeneous designation - that there are many variations of state within an alert condition. How well we know the situation. How often, eyes open and seemingly attentive, might we own up to being in less than the peak of alertness? Without electrophysiological measures, however, it is difficult to document this. But, is it possible that some of the more finely described "process" measures used by Colombo such as number of fixations, proportion of time off the stimulus and shift rate may be indirect gradations of state fluctuations during an attentional episode? Might these account for the lack of task to task consistency and for some of the unaccounted variance of the early to later measures?

This introduces the third theme - the one I said I would extract from these papers. It is that there is progress to be

made in the finer grained analysis of the novelty preference task and of the habituation/dishabituation task. These kinds of analyses will permit us to ask questions of the processes involved in information processing, in learning, and in the encounters with the informational environment that so dominates the infant's waking hours. In addition, state and its variability and its contribution to information processing is likely a component to be dealt with. Elsewhere, Colombo and I (Colombo and Horowitz, 1987) have discussed the importance of state as a lead variable in neonatal research. It is possible that while there is no reason to consider it a lead variable in the information processing behavior of older infants that it ought to be considered a more significant variable than is our want when we set up the experimental situation by defining the conditions as having the infant in an "alert" state.

In the quest to understand the role of information processing behavior as an individual difference characteristic, it is important to keep in mind that the goal is not to document significant predictions but to account for more and more of the variance of the developmental outcome phenomena. The "moderate" level of prediction of these information processing measures for later developmental status is now well established. It is important to test other measures such as those Fagan and his colleagues are using to see if they show similar properties. But it is also important to do the kind of psychometric parametric work that Colombo and Rose and Feldman have reported here. More important are the specific task measures for the more explicit description of process and the implications that may be derived from introducing the role of state. State variability and state

organization may, themselves, be individual difference characteristics that will permit us to describe how the infant manages and modulates his or her behavior during a complex and probably not homogenous attentional episode.

Rose and Feldman have made the point that prediction of later intelligence from early measures is constrained by the reliability of those early measures. If reliability is, itself, influenced by state factors then the addition of state measures or some characterization of individual differences in state organization and management may be an important source for increasing the amount of variance for which we can account.

I have said elsewhere and will not belabor it here - that the question of discontinuity and continuity in development is not properly one of relating one phenomena to its manifestation or a variant of its manifestation at a later point in time. Rather, the question of continuity and discontinuity is more properly framed as one of the continuity and discontinuity of processes. The kind of research reported here today exemplifies the kinds of strategies that permit us to look at process rather than phenomena - and it is these kinds of strategies which will ultimately add power to developmental analysis.

References

Bornstein, M. and Sigman, M. (1986). Continuity in mental development from infancy. Child Development, 57, 251-274.

Colombo, J. and Horowitz, F.D. (1987).

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Figure 1

Table 3

Correlations Between Infant Measures and 27-Month Test Scores

Infant Measures	27-Month Scores: Stanford Binet	Bayley Mental	Bayley Motor	$\bar{X}$
	3 Months			
Retention Ratio	.42**	.39**	.15	.32
Baseline Ratio	.31*	.26*	-.58**	
Bayley Mental	.36**	.45**	.39**	.33
Bayley Motor	.24	.37**	.18	
	7 Months			
Retention Ratio	.51**	.54**	.22	.33
Baseline Ratio	.39**	.29*	-.05	
Bayley Mental	.33*	.30*	.30*	.29
Bayley Motor	.25	.23	.38**	
	11 Months			
Retention Ratio	.46**	.32*	.14	.24
Baseline Ratio	.28*	.18	.09	
Bayley Mental	.24	.40**	.11	.26
Bayley Motor	.13	.15	.58**	

Note. Correlations with baseline and retention ratios are pooled within-cell correlations adjusted for retention interval.

*p [.05. **p [.01.